NAVAL WAR COLLEGE

FUELING THE OPERATIONAL BATTLEFIELD

BY

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The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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THIS STUDY EXAMINES THE PROBLEMS ASSOCIATED WITH MAINTAINING DISTILLED BULK PETROLEUM FUEL STOCKS IN THE OPERATIONAL BATTLEFIELD. WITH THE EMPLOYMENT OF MECHANIZED GROUND FORCES, ROTARY AND FIXED WING AIRCRAFT, AND VEHICLES THAT ARE DEPENDENT ON PETROLEUM FUEL, THE OPERATIONAL COMMANDER COULD FACE SERIOUS TACTICAL AND STRATEGIC PROBLEMS IN HIS PROSECUTION OD A WAR IF HIS FUEL SUPPLIES ARE DESTROYED. OF PARTICULAR IMPORTANCE IS THE JEOPARDY OF FUEL SUPPLIES, IN THE OPERATIONAL BATTLEFIELD AND IN THE THEATER, WHEN ANALYZED THROUGH A KOREAN PENINSULA WAR SCENARIO. THE SIGNIFICANCE OF FUEL SHORTAGES HAS PROVEN TO BE A CRITICAL VULNERABILITY IN THREE HISTORICAL CASES THAT ARE CITED IN THIS STUDY. A CLEVER AND DETERMINED ENEMY CAN DESTROY OR DENY THE USE OF TACTICAL, THEATER, AND STRATEGIC FUEL SUPPLIES WITH THE END RESULT BEING THAT AN ALLIED VITORY IN ANOTHER KOREAN WAR MAY WELL BE JEOPARDIZED BY LACK OF FUEL AVAILABILITY TO THE OPERATIONAL COMMANDER IN THE FIELD

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Abstract of

FUELING THE OPERATIONAL BATTLEFIELD

This study examines the problems associated with maintaining distilled bulk petroleum fuel stocks in the operational battlefield. With the employment of mechanized ground forces, rotary and fixed wing aircraft, and vehicles that are dependent on petroleum fuel, the operational commander could face serious tactical and strategic problems in his prosecution of a war if his fuel supplies are destroyed. Of particular importance is the jeopardy of fuel supplies, in the operational battlefield and in the theater, when analyzed through a Korean Peninsula war scenario. The significance of fuel shortages has proven to be a critical vulnerability in three historical cases that are cited in this study. A clever and determined enemy can destroy or deny the use of tactical, theater, and strategic fuel supplies with the end result being that an Allied victory in another Korean war may well be jeopardized by lack of fuel availability to the operational commander in the battlefield.

THE LIFEBLOOD OF THE ARMY

The life blood of a modern military machine is the fuel that burns in its internal combustion engines. Without fuel, battlefield forces cannot move forward, provision themselves, or disengage from a mechanized enemy. In all would-be battlefields throughout the world, the amount of fuel available to the operational commander will heavily influence tactical operations and contingencies as no other consumable product can. Nothing else in battlefield logistics can substitute for the precise fuels required to operate a tank or truck, fly an aircraft, or spark a generator supporting command and control facilities. Only with great difficulty can shortages of fuel be rectified either as a spot measure or as a major resupply effort. The history of modern warfare since 1914 is replete with examples of fuel shortages having decisive effects on battlefield operations, thus adding another line item to the legendary "Tyranny of Logistics". Of particular importance for tacticians and an operational commander analyzing a potential Korean Peninsula fight, is the prognosis for adequate fuel supplies being accessible to the operational commander in that theater. Allied victory in another Korean war may well be jeopardized by lack of fuel availability to the operational commander in the battlefield.

BLEEDING THE BULL

"What I want to avoid is that my supplies should command me."
Comte de Guibert: Essaie General de la Tactique, 1770[1]

Reviewing the second invasion of South Korea by her northern neighbor in this century, there were signs of impending hostilities. The Baltic Exchange had been bombed for the second time in the last two decades, only this time the bomb was well placed internally, and the Exchange ceased doing business. The Baltic Exchange, the London based commercial shipping clearinghouse, is the headquarters for brokers involved in matching ocean-going shippers with shipowners in contractual agreements to haul bulk cargo. With the closure of the Exchange and the loss of so much data, very little new shipping activity was taking place. Asian shipping centers would attempt to assume Baltic business as best they could. This act of terrorism was

relatively unnoticed because of the war scare in the Korean Peninsula and the sudden energy crisis brought on by a shortage of industrial grade fuels. Prior to the bombing, the world product oil tanker trade had been unusually brisk. For about three months prior to the bombing, product tankers had begun to be chartered to haul diesel fuel, aviation grade fuels, and gasoline in patterns that resembled a general attempt to create an extraordinary and artificial world shortage of refined fuels. Unidentified investors were attempting to influence the futures market by concentrating their investments on fuels, tying up large loads of fuel at sea, as a substitute for land storage. These product tankers were now unavailable to meet the chartering demands of routine global business. A fuel crisis had developed and it seemed that a profit motive was part of the cause.

The industrial nations felt the pinch first from this play on the market. It did not take long for a fuel crisis to surface. Fuel and energy companies began hoarding supplies, consumer prices sky-rocketed, the government fuel reserves of various countries were already being juggled to ease the pain for international and domestic transportation companies and to keep the economies of the world performing well. The war that had broken out in the Korean Peninsula was hardly noticed.

The sensational pre-invasion raids conducted on South Korea could have been headline grabbers if it were not for the energy crisis. During 48 hours of attacks by North Korean special forces and various terrorist groups, Allied civilian and military theater storage facilities were decimated. Fuel farms in Japan, Okinawa, Guam, the Philippines, Hawaii, and Long Beach, California, were also attacked by unknown assailants. A few of the terrorists who committed these attacks were killed at the scenes of their crimes. The physical makeup of these terrorists fit no particular pattern of preponderance. There were Asian, Anglo-American, Middle Eastern, and Latin American men and women, and the legal documentation that could be correlated to them supported the premise that they were not all American citizens. In South Korea, the country-wide panic caused by 14 million people fleeing Seoul, the fourth most populated city in the world, had caused all available food, coal, medicines, and refined fuels to be swallowed

wholesale. All highways, railroad arteries, and river courses leading south toward Kwangjue, Yosu, and Pusan were choked with refugees the same as they had been in 1950. None of the large ships caught inport at the commencement of hostilities could depart because of the sea mines that had been laid. The combined military response of the United States and South Korea was set in motion as had always been planned. The ammunition and fuel that had survived the initial commando assaults was quickly depleted. The war went more than 21 days, at high tempo. The Allies were out of fuel and ammunition at the front lines and everywhere else between the troops and the ports. Line haul trucks and other transportation and logistics assets had been singled out for ambush and sabotage. American casualties were higher than tolerable or expected.

The mobilization and resupply efforts in the United States were chaotic. A sense of urgency had been prevalent simply because there would not be time to build up strength as there had been in Operation Desert Shield. Maritime Prepositioned Ships proceeded toward safe, unmined, water off the South Korean coast with additional equipment and fuel. They remained in various operating areas awaiting mine countermeasures efforts to clear the ports. Military Sealift Command feverishly tried to locate and bring under contract any private product oil tankers that were available to haul resupply fuel to the Western Pacific. The loss of the Baltic Exchange had severely complicated locating appropriate product tankers in the worldwide search. The reactivation of reserve tanker assets had been ordered soon after the invasion, but the process proceeded too slowly in relation to the lightning fast progress of the invading forces in Korea. Simultaneously, panic buying of all types of fuels throughout the industrialized world aggravated the fuel shortage.

The combined ground and air forces in the Western Pacific were unable to overcome the initial operational setbacks caused by losses of fuel from sabotage. A valiant effort had been made to stop the invaders, but there was not enough fuel in theater to sustain high tempo operations on the ground or in the air. Resupplies of fuel were not to be expected for over 35 days by sea. The air tanker assets had been stretched to the limit and were in direct competition

with the combat aircraft for the in-theater fuel that had been available for apportionment. The great military machine used in defense of South Korea ran out of fuel on the 24th day of war. This time the enemy stood to win the war by weakening its adversary at his most vulnerable link in his logistics chain: the bulk fuel supply.

THE PETROLEUM BLOOD OF THE CENTER OF GRAVITY

"Thus, those skilled in war subdue the enemy's army without battle."
Sun Tzu: The Art of War[2]

The concept of the mobile battlefield is built upon the notion that troops and their war machinery will be able to maneuver about the field unencumbered. Each side in the contest for victory will attempt to outflank, envelop, or out-shoot his opponent and reach a decisive point where victor and vanquished disengage from battle. For Sun Tzu, the battle should be won well before it is ever fought. Whereas it is very difficult to defeat an enemy in war without having to fight him, the dictum of Sun Tzu calls out to our adversary tactician to analyze ***his*** enemy and calculate where *his* enemy's weaknesses may be found. Once the weakness is found, the dictum enjoins him to attack his enemy with the clear purpose of exploiting the weakness. If his enemy is strong in his capabilities to conduct a technological war of annihilation utilizing mechanized forces and precision guided munitions delivered by aircraft, then he must aim *his* attack at that strong capability in the enemy strategy. Inherent in the strong capability is a shrouded weakness to be exposed, and you take aim at that weakness in your attack. In this respect, Sun Tzu is the same as Clausewitz in calling for thrusts against the enemy's center of gravity. Both argue from operational analyses in identifying center(s) of gravity. Clausewitz identifies the army as the center of gravity on the battlefield and Sun Tzu identifies the enemy's plans as the focal point for attack.. What Clausewitz could not have forseen was the addiction to a vital fluid that would be needed by all modern forces. That vital fluid is distilled petroleum fuel of various grades. Sun Tzu could not have forseen that distilled petroleum fuel would be virtually the energy source for all modern military forces that allowed them to animate their plans and strategies. Fuel is the

lifeblood of the military. For the operational commander who has charge of modern weaponry, the often ignored vulnerability of his center of gravity is his fuel supply.

The concept of fuel as the lifeblood of the center of gravity is readily apparent when laid upon the requirements for fielding a modern military force. That force is transported by non-nuclear powered sea, air, and land vehicles that all require distilled petroleum fuel(s) to function. The controlled temperature environments of command and control centers, field hospitals, communications nodes, et cetera, operate with electricity generated by various sized power plants from portable types to permanently placed structures. The fighting vehicles themselves are fueled by petroleum products that are refined hundreds if not thousands of miles from the battlefield. Distilled petroleum fuel is burned in the engines of transport platforms whose mission is to deliver their cargo fuel loads to the fighting vehicles engaged in warfare, as well as their ammunition, and their oils and lubricants, and the provisions for the national and combined troops. Fuel sustains the combat air patrol and the air intelligence sensors overhead, and fuel animates the logistics bridge from one base to another forming the continuous line of communication back to wider network of war supplies. Fuel is required to claim, remove, and repatriate the battlefield dead. Refined fossil fuel and its availability make the American way of war a reality.

The operational commander must always consider his current and projected fuel supply when developing his immediate and sequel operational plans. The commander must understand and master the source of his fuel supply. He is obligated to know how his fuel is distributed throughout the theater. He must possess a thorough knowledge of the military equipment, facilities, and constraints under which he will fight. He must also possess a great knowledge of the civilian and commercial equipment, facilities, and their potentials for military use in the event of unforeseen emergencies. Through his knowledge of the fuel supply and distribution system, the operational commander can identify the weak links in the logistics chain and plan accordingly for bolstering the brittle pieces of his chain.

JOINT BULK PETROLEUM DOCTRINE

"What the theorist has to say here is this: one must keep the dominant characteristics of both belligerents in mind. Out of these characteristics a certain center of gravity develops, the hub of all power and movement, on which everything depends. That is the point against which all our energies should be directed... If the enemy is thrown off balance, he must not be given time to recover."[3]
Carl von Clausewitz: On War

The operational commander relies on petroleum stocks that have been pre-staged and gathered for his use in the event of hostilities. Bulk petroleum, as refined fuel, is the energy source that propels combat ground, naval, and air forces. This vital resource poses considerable challenges when planning for its availability to the operational commander when needed. These expensive challenges arise with the transportation links from origin, starting at the refinery, traveling the land-sea bridge to user storage facilities, and arriving at final distribution centers for issue to end users. Joint Publication 4-03, "Joint Bulk Petroleum Doctrine", provides the doctrinal foundation for "joint tactics, techniques, and procedures (JTTP) to govern the joint activities and performance of the Armed Forces of the United States in joint operations, as well as the doctrinal basis for U.S. military involvement in multinational and interagency operations."[4] It is critical that the operational commander and his staff understand the tenets of this doctrine for bulk petroleum supply and identify its inherent weaknesses as the accepted panacea for fuel requirements.

The military management of bulk petroleum as a viable support concept rests on three principles[5] :

1. Standardization: Department of Defense components should minimize the number of bulk petroleum products that must be stocked and distributed, plan to use fuels readily available worldwide, and minimize the military-unique characteristics of DOD fuels.
2. Flexibility: Military weapon systems and equipment must be capable of using alternate fuels while sustaining acceptable performance ratings.
3. Interoperability: Military fuels handling equipment and connectors must be interoperable among service branches with common or compatible design, material, size, and, when possible, with allies and coalition partners.

The Department of Defense has made great strides in attempting to minimize the number of bulk petroleum products that are needed in the battlefield. However, this evolutionary concept in reorganizing, reducing, and restocking bulk fuels remains incomplete. In the case of Korea, the bulk petroleum requirements have been changed to conform to the single battlefield fuel doctrine. This doctrine has been implemented for United States Army and Air Force tactical vehicles and aircraft, and uses an aviation grade fuel as the standard propellant. However, the multiple fuel program will not go away. Commercial construction equipment, such as those types used by combat engineers, will not accept an aviation grade fuel as a substitute for diesel fuel. Also, United States military non-tactical vehicles, generators, and the Republic of Korea vehicle fleet that support combined forces remain beyond the curative effect of the doctrine change. This single fuel doctrine will also not address the needs of the navy to stock marine grade diesel for ships or JP-5 for naval jet aircraft. The scope of the bulk fuel problem will be diminished as a non-fungible tactical requirement, but not solved.

The flexibility the operational commander has in substituting the fuels used by various fighting vehicles and rotary wing aircraft is great, yet limited by the availability of fuel. In a crisis scenario such as was outlined in previous paragraphs, the scarcity of fuel would negate much flexibility. In a general war in Korea, precipitated by a lightning strike against theater and resupply fuel stocks, military forces will be overwhelmed by the scramble for fuel assets in direct competition with the civilian sector for the finite fuel resources remaining. It is impractical to think that the military forces will enjoy easy and complete access to all the available theater fuel stocks that are controlled by private enterprise. These stocks could be legally, as well as physically, beyond their reach. Civilians will lay claim to a portion of the available fuel to pursue legitimate endeavors such as ambulance services, firefighting, police operations, evacuation of people and property, et cetera. Competition and friction is bound to develop between military and civilian factions for what fuel is available.

Interoperability of refueling equipment within the United States military structure is not always a pleasant experience, but usually does not pose insurmountable problems. The concept

of interoperability of equipment, when applied to combined forces and how they share the equipment needed to refuel their vehicles, also usually works. Common and compatible designs have been the focus of decades of development seeking common functional designs. In a crisis, the biggest issue involving interoperability will probably be the immediate location of the needed fitting to service the infrequent customer, that has just rolled up to the pump, in the middle of the night, and in a very big hurry. Invariably, the special tool required to couple the special nozzle to the appropriate hose, will be missing from its special cradle, at the most innappropriate moment. Every sailor that has worked a flight deck, any soldier that has been in the motor pool business, and any airmen that has worked the "hot pits" has an appreciation for this anonymous "Mother of All Gadgets" that has the power to delay combat stikes. The real problems with theater fueling in support of the operational commander, unfortunately, are not something to smile about.

BULK PETROLEUM AND THEATER SUPPORT CONCEPTS

"I don't know what the hell this 'logistics' is that Marshall is always talking about, but I want some of it."
Fleet Admiral Ernest J. King, USN, 1942[6]

The operational commander will utilize the fuel stocks that are present in theater when hostilities commence. These stocks, better expressed as large amounts of fuel in large storage tanks, are those fuel levels accumulated as a result of the standard supply process of requisition and fill. Theater components draw their daily peacetime fuel needs from their primary operating stocks. It is the geographic combatant commander's responsibility to ensure that adequate fuel stocks are maintained in theater. This responsibility is executed through the Joint Petroleum Office, who works in conjunction with the Defense Fuel Supply Center, to plan, coordinate, and oversee all phases of bulk petroleum support for U.S. forces employed or planned for possible employment in the theater.[7] The primary operating stock is recalculated annually by the Defense Fuel Supply Center to ensure that their global customers' requirements are anticipated and met

without delay or shortage. Therefore, the final customer sees his fuel coming from his service component direct support organization in the quantities and grades requested.

The Korean Peninsula, at least in the South Korean section, is considered a developed theater for the distribution of bulk petroleum products. It has modern port terminals to receive product tankers, facilities to store their cargoes of fuel, and an inland infrastructure for distributing the fuel throughout the country. South Korea possesses sufficient roads, railways, and pipelines to distribute peacetime allotments of fuel to both the civilian sector and combined forces military bases. A generic military Bulk Petroleum Distribution System for a developed theater is depicted in Figure 1. In a foreign country, the infrastructure will most likely be a host-nation system of distribution that is shared by U.S. and indigenous forces. In the Korean

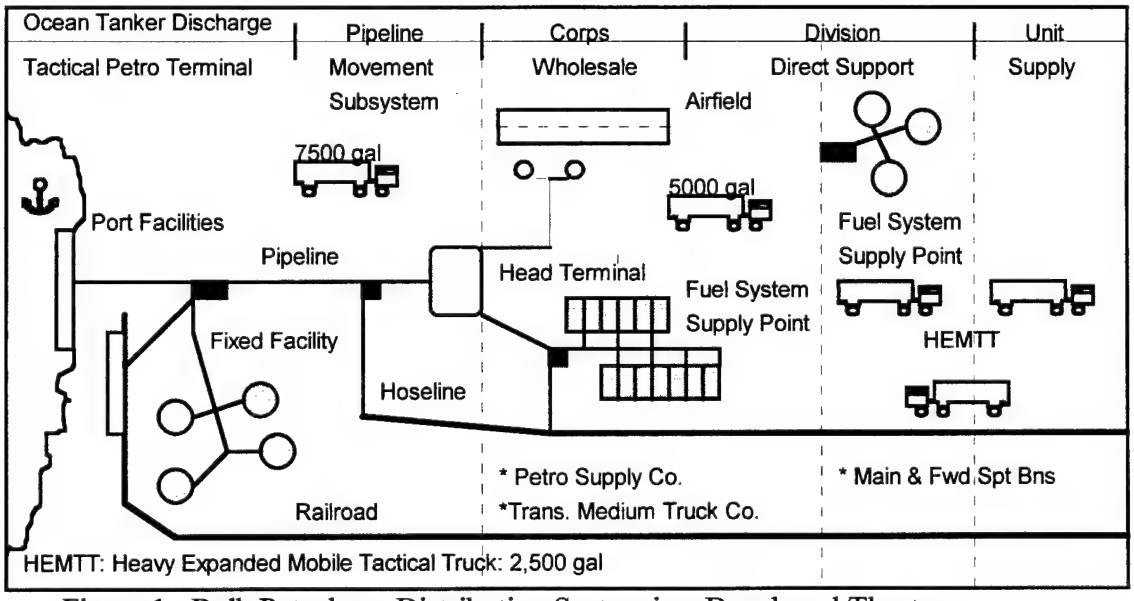

Figure 1. Bulk Petroleum Distribution System in a Developed Theater
Source: Joint Publication 4-03. Joint Petroleum Doctrine

Peninsula, a preemptive strike against the established infrastructure will wreak havoc on the fixed facilities used for storage and distribution.

The operational commander must appreciate that a strike against the Bulk Petroleum Distribution System, in a developed theater, will have the objective of destroying bulk supplies of fuel as well as compartmentalizing fuel storage and line haul capabilities. The enemy goal

would be to cancel the ability of the operational commander to refuel his forces when required. This will cause operational delays, pauses, and course of action changes due to lack of fuel (i.e. mobility). The predicament that would develop applies to ground as well as air forces in having a negative effect on operations. The outright destruction of fuel is useful to the enemy up to the point where it causes immediate shortages for the operational commander's forces, thus affecting his courses of action. The compartmentalization of the fuel distribution system at various fuel system supply points will serve the double purpose of isolating consumers from their fuel as well as providing a ready source of fuel to the enemy should he be able to overrun the site. This isolation is accomplished by attacking pipelines, hoselines, and line haul truck assets. Fuel Service Tank Trucks in particular are critical to the operational commander for sustaining his of force mobility. As such, their loss from attrition is difficult to recover from in a combat theater, primarily due to their limited numbers, specialized design, and hard to duplicate mission. With line haul Fuel Service Tank Trucks in diminished availability, the cascading effects of no fuel in vehicles and aircraft will quickly be felt in all phases of operations. The manifestation of empty fuel tanks will mire logistics efforts to the point where that effort will not be able to sustain its own momentum, much less the momentum of combat forces. The enemy's desired tactical result and measure of effectiveness will be general loss of mobility, dwindling ammunition stocks, and no fuel resupply availability for Allied forces.

The raw effect of the loss of bulk fuel assets will be seen in the absence of air forces from overhead tactical and operational missions. Sortie rates for all types of aircraft will ultimately fall off from lack of theater fuel supplies regardless of air-to-air tanking capabilities originating from third country airfields. In the Korean scenario, sabotage would be carried out throughout the Pacific Rim to create an immediate fuel crisis and cause tremendous complications for air refueling and air bulk resupply contingency planning. The acute problem with air resupply assets is they are appreciably harder to sustain for prolonged periods of time during high tempo operations.

The key elements in the enemy's need to strike at the Pacific Rim fuel assets are: the distance separating fuel sources from consumers and the calculus of apportionment. With limited assets for air-to-air refueling being available, the cycle time for completion of a refueling mission will be tenuous as the air tanker returns to its third country base to reload. If the enemy was successful in destroying a significant portion of the fuel available at existing nodes, such as in South Korea, Japan, Okinawa, and Guam, then fighter and bomber coverage over the Korean Peninsula becomes much harder to maintain. The element of separating fuel source and consumer is built upon the notion that fuel is a consumable product that has a time and space resupply equation that is much more difficult to solve in a short war scenario than is the case with being able to fly more aircraft into theater. The fuel component of aviation operations is the easiest mission essential item to destroy and has decisive results: it has no replacement, substitute, or "work around" contingency, and it cannot be manufactured at the air base. Killing the fuel stocks keeps planes on the ground, their weapons systems in check, and the ground forces relying on them in waiting.

The calculus of apportionment will decide which targets will be attacked and which targets will remain active to prosecute the war. The calculus of apportionment is concerned with mission tasking and ground support, and the operational commander will have to decide how the remaining fuel will be divided among the competing forces. If the enemy has severely crippled the Bulk Petroleum Distribution System, then the expedient course of action will compel the operational commander to focus support on those components that he has an established line of communication with and is still capable of supporting. Other forces will have to await relief, fuel, and supplies. Sources of fuel will have to be quickly located and provisions made for the transport of that fuel. Air forces will be the likely forces competing in the apportionment equation as they are better able to cross greater distances to seek the available fuel. Time will be a critical factor working against the defending forces. Competing with combat forces for the surviving fuel will be the logistics and service forces as well. The operational commander will be very hard pressed to find his way through the fuel disaster if the enemy can charge down the

Peninsula in four weeks, herding a stampede of 14 million evacuees in front of him in an area slightly larger than the State of Indiana and not nearly as fla

RESPONDING TO THE FUEL CRISIS

"Supply and transport stand or fall together; history depends on both."
Winston Churchill: The River War, viii, 1899[8]

When the enemy attacks, the operational commander should be cognizant that a major objective of the enemy will be to sever the lines of communication between the defense forces and their logistics bases. In the Korean Peninsula, the enemy must deny Allied forces access to fuel. General Douglas MacArthur warns, "The deep envelopment, based upon surprise, which severs the enemy's supply lines, is and always has been the most decisive maneuver of war. A short war envelopment, which fails to envelop and leaves the enemy's supply system intact, merely divides your own forces and can lead to heavy loss and jeopardy."[9] The operational commander has recourse to employ countermeasures to alleviate his fuel shortages if time permits.

The enemy attack will reduce the theater Bulk Petroleum Distribution System from one that is characterized by maturity and meticulous development to one that is dysfunctional and compartmentalized. This forced reversion to a Bulk Petroleum Distribution System that is incapable of performing its rudimentary functions would be the result of sabotage and guerrilla activity. The Operational Commander can employ systems such as the Joint Logistics-Over-the-Shore (JLOTS), Offshore Petroleum Discharge System (OPDS), Inland Petroleum Distribution System (IPDS), and the Amphibious Assault Bulk Fuel System (AABFS) to build an interface between the damaged petroleum distribution system and newly arrived bulk fuel sources. These systems are designed to develop and provide rudimentary bulk petroleum distribution capabilities in an undeveloped theater. The destruction of the preexisting petroleum distribution system would mimic the basic characteristics of an undeveloped theater: impassable roads, absence of a functional railroad system, unusable pipelines, sparse storage facilities, and an inadequate indigenous ground motor transportation system. These rudimentary systems can

be fused to provide for delivery of bulk petroleum products directly ashore to various configurations of tactical petroleum terminals that serve to filter, store, and test bulk fuel products. From these terminals, the bulk fuels can be further distributed to consumers in the field via tank trucks, hoselines, or if the situation is grave enough, 55 gallon drums or other containers. A Bulk Petroleum Distribution System in an Undeveloped Theater is depicted in Figure 2.

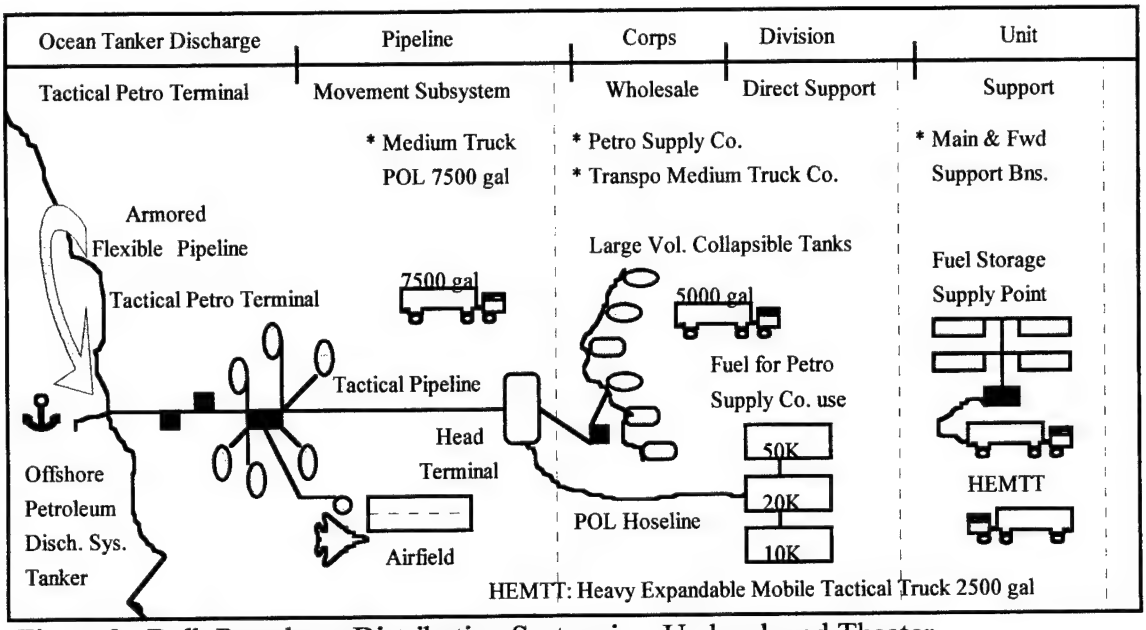

Figure 2. Bulk Petroleum Distribution System in a Undeveloped Theater
Source: Joint Publication 4-03. Joint Petroleum Doctrine

The undeveloped theater system differs from the developed theater system in that the system designed for the undeveloped theater relies heavily on portable fuel bladders for storage, and the system linkage with product tankers is via the Offshore Petroleum Distribution System and its flexible hose assembly. This equipment must be ready to be received at an appropriate site that is within the parameters of the system: 35 to 190 feet of water for the Single Anchor Leg Mooring (SALM), within 4 nautical miles of the shore terminal, up to sea state 3 for general operation (i.e. maximum 40 knot winds, 4 knots of current, and 12 foot waves), and sea state 5 for equipment survival.[10] Battle space dominance must prevail for the duration of the conflict

to ensure that insurgent activity does not destroy this very specialized offshore system. Therefore, responding to the operational fuel crisis created by an enemy attack is a deliberate effort that is fraught with risk and requires generous amounts of time to implement the corrective measures.

There are other problems that can materialize that further slow the flow of fuel. A severe complication can arise for the operational commander if he must respond to the laying of sea mines in areas that are conducive to the use of portable systems. Mine countermeasures efforts would have to be completed prior to the implementation of portable systems. The enemy would have to be denied the capability to lay additional mines if a dependable resupply system is to be established. The mine countermeasures clearance problem would also have to be solved prior to the commencement of discharge activities at a port facility that was spared from attack, thus making portable systems unnecessary. Mine countermeasures operations are time consuming, equipment intensive, and dangerous, and none of these aspects of the countermeasures effort is good news for the operational commander or the fuel starved vehicles. Any actions undertaken by the operational commander to restore the flow of fuels to his forces in the battlefield bring on the gamble that this restoration will be timely and will provide the quantities of fuel needed. The enemy, for his part, will continue to deny the Allies access to fuel or will throttle the line of communication in such a way, and as best he can, in order to ensure inadequacy of fuel supplies. The clear measure of effectiveness for the enemy commander in his quest to attack the fuel supply will be Allied vehicles stalled on the road, immobile in the field, or caught in static positions that are hard to defend.

HISTORICAL PERSPECTIVE OF FUEL IN THE BATTLEFIELD

"Communications dominate war; broadly considered,
they are the most important single element in strategy, political or military."
Alfred Thayer Mahan: The Problem of Asia, 1900[11]

History has recorded many wars and battles where the victorious military forces have accomplished wondrous feats of martial prowess. From Cannae to Inchon, maneuver warfare at

the tactical, operational, and strategic levels have shone brightly as the apparent host of victory. The lines of advance have been laid upon historical maps to show the assault routes taken and symbols accompany the lines to record force composition and strength. Very little discussion concerning the logistics lines of communication has attended the broader reporting of how battles were supposedly won. The operational commander who is well versed in the historical tenets of how fuel supplies affected the course of celebrated military operations is better prepared to spare his forces the agony of repeating the defeats of past armies.

When analyzing fuel usage in the operational battlefield, three glaring historical cases leap out to capture the attentions of the operational commander. The first case is the defeat handed to the invading German Army by the Soviet Army in the Battle of Stalingrad in 1943. The second is the precarious operational circumstances of the Allied forces in France, in the fall and winter of 1944, when the Broad-Front Strategy sputtered to a halt as it pushed toward the German Frontier. The third case is the blunting of the North Korean offensive to break through the Pusan Perimeter and destroy the Allied forces caught on the Korean Peninsula in 1950. Each of these cases had its outcome determined by the availability of fuel to the forces in the battlefield.

In the case of the German Army, the backbone of that force was built upon the employment of the motorized truck. For Blitzkrieg warfare, the rapid movement of mechanized forces, tactically supported by aircraft and logistically supported by the motorized supply corps, was key to the early successes of the Nazi land forces in World War II. Petroleum supplies had to be steady in order to fuel this force, and it was imparted to the German and Greater European railroad system and network of roadways to demarcate the lines of communication.

There were drawbacks, however, to the German reliance on the railroads and roadways to bring fuel and other supplies to the Nazi Armies. The increased use of trucks as line haul assets meant that greater resources, in terms of fuel, personnel, spare parts, rubber, lubricating oils, and routine maintenance, had to be devoted to sustaining the truck transportation arm of Nazi field logistics.[12] The cost of carriage for trucks, per mile of cargo hauled, was vastly more expensive

than the railroad equivalent in hauls of more than a couple of hundred miles. Though Hitler had decided to mechanize only portions of his army, he neglected to fully support the in-depth development of his line haul trucking capability. Mechanized divisions spearheaded his Blitzkrieg offensives and the remainder of his army walked alongside horse drawn carriages and wagons. The railroad was exploited whenever possible to haul personnel, equipment, fuel, and supplies. Yet, the railroad was not conducive to maneuver warfare, especially when train routes did not follow, or parallel the army's lines of operation, or when the right of way had been destroyed. For instance, in the Polish campaign in 1939, the destruction of the railroad system in that country was so complete that trucks were quickly worn out from heavy usage in attempts to fill the gap of lost railroad capacity. Therefore, limited trucking assets were employed to haul fuel and supplies from the railroad terminus, wherever that might be for a given operation, to the front lines. These trucking assets were in great demand throughout the strategic theaters of operation (i.e. Poland, the Low Countries, France, Africa, etc.) as they were continuously shuttled and time shared by army units on the move. It was only to an unsatisfactory extent that captured vehicles were able to alleviate the overall German truck carriage problems.

Hitler exacerbated his line haul problems when he executed Operation Barbarossa in the summer of 1942 without adequate transportation assets available to the army. The forces employed in the invasion of the Soviet Union plunged quickly and deeply into the interior of that country, part of a short term operation designed to force Soviet capitulation. It was soon apparent that the railroad system in the Soviet Union could not be repaired quickly, or have the gauge changed to accommodate German rolling stock in support of the advancing Nazi troops. Hitler's three pronged offensive aimed at Leningrad, Moscow, and Stalingrad, divided his forces and their attendant lines of communication, into inflexibly pronged transportation corridors that were laterally separated by very long distances. The rail lines were unable to match the progress of the invasion army nor able to meet the operational requirements of the separated forces. Scarce trucking assets were, therefore, transported from the Western front to haul fuel and supplies along the tenuous lines of communication from the railroad terminus. Attempted

resupply of fuel by airlift failed, and also caused serious losses to the Axis in terms of destroyed aircraft and lost opportunities to carryout other missions using those very same airplanes.

In the Stalingrad sector, the push to restore railroads progressed slowly. The troops allocated to this task were unskilled and poorly supplied with little fuel or equipment. The consequences of lost railroad support was that fuel and other supplies could not get through the long supply route to the areas close to front line troops. With little fuel getting through, the available trucks standing by to haul the supplies that did arrive were in essence competing with their customers for the same fuel supply. An axiom developed; it requires fuel to haul fuel. The final result at the front line of this fuel crisis was that combat vehicles ran out of fuel as the Nazi forces were on the verge of capturing the oilfields of the Caucasus'. Fierce Soviet resistance and counteroffensives began to roll the Nazi invasion backward toward the Fatherland. The German flow of fuel had become disjointed and the machinery of war was halted. Lack of fuel cost them the offensive.

In the case of the Allied forces and the Broad-Front Strategy, the fuel situation in France, in 1944, was precarious. The animosity between the Allied generals, each pitching his signature post-Normandy strategy for Allied victory and laying claim to the equipment to support it, was an enmity that was manifested in the struggle to control limited resources. The Supreme Allied Commander settled the post-Normandy strategy question with a plan heavily influenced by logistics capabilities and how these capabilities could best support various ground force strategies.

Upon the breakout from the Normandy beachhead, Allied armies uncoiled an unanticipated lightning thrust across France that placed forces, at one point, 252 days ahead of phased and synchronized logistics support. The lines of communication could not, nor had they planned to, keep pace with such a lightning type of advance. Stop-gap measures such as the "Red Ball Express", a circuitous non-stop truck route from Normandy to the Allied front, could not solve the unplanned for tempo problem. For the scope of operations, the trucks were inadequate to keep the army rolling and were incapable of delivering enough excess fuel and other supplies to

the forward dump areas to build an operational reserve. The French railroads, that had been destroyed by D-Day preparatory aerial bombing, could not be repaired or reactivated fast enough to rush fuel through Paris to the frontier combat forces. Airlift resupply efforts repeatedly failed to match its predicted capacity.[13] The capture of the City of Paris ahead of schedule added to the burden of food and fuel that had to be supplied. The supply conduits into the French interior emanating from the Normandy beachhead and Cherbourg were strained to the limit and so was the PLUTO underwater pipeline system crossing the English Channel. Additional port facilities along the English Channel and North Sea that could be used to widen the supply conduits were opened only at a pace consistent with naval mine sweeping progress along the coast, [14] ground forces advancement, and the completion of port facilities repairs. Critical shortages of fuel and other supplies developed, a type of slow down that could not be massaged out of the ensuing combat paralysis.

The 12th Army Group deployed south of the Ardennes was identified as the organization that would bear the burden of fuel sacrifice for other forces.[15] It was clear that the pursuit of large scale operations would remain impossible until the Port of Antwerp were opened and adequate rail capacity was made available. Hitler also had his own fuel and transportation problems negatively influencing his operational planning. The Allies had executed the Transportation Plan, a bombing strategy that was designed to destroy the Nazi controlled rail system. This plan had its desired effect of dissecting the rail system in preparation for the D-day invasion and the sequential operations to follow on the continent of Europe.[16] Thus, the German forces were becoming increasingly immobile at the operational level from lack of fuel and other basic provisions of war that required bulk transport. The Battle of the Bulge was the last major offensive undertaken by the Nazis prior to their running out of fuel. It was launched against the Allied forces on the Western Front, through the Ardennes, simply because the forces deployed there were known to be numerically weaker than the Soviets were anywhere on the Eastern Front. There is no evidence that the Nazi strategists were aware of the acute fuel shortages suffered at the Allied front lines. The Nazi offensive was stopped as much by its own lack of

fuel, as it was stopped by the valiant Allied efforts to use combat force to grind it to a halt. During this emergency, adequate quantities of fuel were rushed to the Ardennes area forces and the flanking 12th Army Group that enabled those forces to engage the Nazi offensive in its drive to the sea and stop it.

The Allied operational pause that resulted from fuel shortages was a factor that invited Hitler to attack through the Ardennes.[17] This final thrust almost succeeded in destroying Allied gains in France up until that time, and this thrust had the very real potential of unravelling the entire Allied presence in Western Europe. Lack of fuel at the operational and tactical levels invited this near disaster by hampering the operational commanders from executing their strategies against the Nazi defenders. Bulk fuel, therefore, and the access to adequate stocks of it, proved decisive for both winner and loser in the Ardennes offensive of 1944.

The final case offered for examination is the Pusan Perimeter. The relentless Communist push south after the 25 June 1950 invasion across the 38th Parallel was not blunted until the North Korean forces were poised to capture the port city of Pusan and annihilate the Allied forces separating them from conquering the entire Korean peninsula. It was at the margins of the Allied defense pocket, which became known as the "Pusan Perimeter", that the fury of the North Korean attack was irrevocably spent by the tenacious efforts of the Allied defenders. These defenders were supported by the uncastigated flow of resupply fuel, ammunition, personnel, and equipment into the rear echelon of the Perimeter from sources in Japan, Southeast Asia, Europe, and the United States.

The North Korean drive toward the stalemate that was the Pusan Perimeter had the very real side effect of thinning out the North Korean lines of communication. The overall scope of Allied air operations against these lines of communication proved ineffective throughout the war[18] and made little difference in the outcome of the Pusan Perimeter fighting. The Inchon invasion was the first decisive blow to sever the Communist supply routes that lead south. For the remainder of the war, the Communists were able to adequately resupply their battlefield forces, the same as the Allies were. The key to Allied resupply success, however, was their

ability to receive ocean transported bulk cargoes at Pusan and Pohang. The inflow of fuel and other supplies allowed for the push north from the Pusan Perimeter in direct pursuit of the retreating North Korean forces. The Allied forces, particularly the American forces, were already caught-up in the penchant for a fossil-fueled war of machinery, enough so that a U.S. Army Colonel commented, "... the U.S. Army is so damn roadbound that the soldiers have almost lost the use of their legs. Send out a patrol on a scouting mission and they load up in a three-quarter ton truck and start riding down the highway."[19] Such as it was in the Korean War, fuel allowed for great mobility in the battlefield.

The extended line of communications providing fuel and other supplies to the Pusan Perimeter found its shore interface in the port city of Pusan. Unblocked as the Pusan entry point was by sea mines, an active insurgency, damaged port facilities, or shortages of product tankers making their runs from resupply bulk storage locations, the flow of fuel made line haul possible for the multitude of stock items and equipment required by a 1950's vintage army. The forces afloat were unhindered by any viable enemy submarine threat and these forces could also receive their fuel and other logistics at all times. The U.S. Air Force, operating from Japan and various South Korean airfields, was able to tap fuel for great numbers of daily missions to inflict what damage it could against an undeveloped country such as North Korea. The Allied war machine moved forward by burning its seemingly limitless, and secure supplies of fuel, while the Communists fell back after the Inchon landing. As the Allied advance north shortened the Communist supply lines, the logistics situation for the North Koreans improved. When the Chinese Communists entered the war, and the Allies did not cut the supply links across the Yalu River, the war dramatically shifted back in favor of the Communist forces. The startling fact that the Communists were not as fuel bound as their Allied opponents, and were still successful enough to fight the Korean War to a draw, calls attention to the fact that there is an Achilles Heel to armies dependent upon mechanized warfare. A critical vulnerability in the center of gravity is the reliance upon bulk fuel supplies in the field.

WHEN AMERICANS GO TO WAR

"We have a claim on the output of the arsenals of London as well as Hanyang, and what is more, it is to be delivered to us by the enemy's own transport corps.
This is the sober truth, not a joke."
Mao Tse Tung: On Guerrilla Warfare, 1937[20]

The operational commander will employ a vast array of mechanized, motorized, and combustion engine powered tools of war. Each of these tools is a vital component of combined arms strategies designed to exploit the technological advantages that the United States marshals over potential enemies. The common denominator for all of these forces is they require bulk petroleum fuel, in uninterrupted loads, to undertake their missions.

The operational commander must remain cognizant of his continuous requirements for fuel, how his fuel is supplied to his forces, how that fuel supply could be disrupted by a clever opponent, and how the fuel flow can be restored if it does become interrupted. The enemy already recognizes that fuel is vitally important to the operational commander in the execution of his mission. The enemy also understands how his opponents fuel supply could be captured and turned into his own fuel supply. Should the North Koreans attack in earnest across the 38th Parallel, they might employ non-persistent chemical weapons to render the Allied fuel dumps temporarily inaccessible or the Allied short-term decontamination effort too costly when balanced against the limited availability of decontamination equipment and supplies. The goal for the enemy will be to capture the fuel farms as it proceeds along its lines of operation, thus easing its own logistics problems. The basic premise will be for the enemy to avoid the quandary of the Germans at Stalingrad and the Allies in the Broad-Front Strategy. Fast tempo warfare, carrying a sustained combat punch, will be required if the enemy is to press his attack successfully to the South Korean coast at Pusan. A weakened Allied force, a bull that has lost his blood, that has lost his essential motive fuel, is a frail force incapable of relying on his petroleum fueled combined arms. The crucial factors for the enemy to completely halt the Allied forces rest upon compartmentalizing Allied fuel sources and dissecting the fuel supply system into crucial nodes.

Vulnerabilities that are identifiable for the operational commander are the links between the fuel supply nodes. These nodes are sequential in the transportation chain and they progress through refining centers, strategic storage facilities, strategic loading terminals, product tanker transportation, theater discharge terminals, theater storage facilities, theater distribution systems, line haul capabilities, and tactical storage and distribution. The key for an enemy attack to succeed in Korea is to disjoint the transportation system at as many of the nodes as possible. The focus will be to create panic throughout the system. The shock wave of a fuel crisis, not only in far-off Korea and Asia, but also in the midst of a startled American public would dismay even the most staunch operational commander and his superiors. The resultant stop-gap, emergency measures, would continue to unravel the well planned and phased introduction of reinforcements from the continental United States in favor of trying to refuel the forces already in theater.

The nodes are within reach of the enemy. Terrorist groups can be united in the effort to assist in the defeat of the United States and its allies in Korea. Our petroleum transportation and distribution nodes are vulnerable to attack,[21] and with little effort, terrorist groups can pursue their individual agendas while also achieving a synergism that can serve the interests of the North Korean attackers in the event of war and the proxy groups. The Baltic Exchange in London, the hub of most bulk cargo commercial shipping contract activity, has been attacked by the Irish Republican Army in the past. Another such attack may not represent an alliance of ideology, but can certainly be a mutually beneficial act that will hurt most at the moment when the Allied weakness to haul to haul bulk fuels across the sea to Asia is most acute. The cover of anonymity and the establishment of the identities of guilty parties in single and multiple acts of terrorism can draw the international press and Allied governments' attentions away from the real issues about to be played out in the Korean Peninsula. The operational commander in an isolated theater such as Korea may not captivate very much overt attention in the eye of the public. This will only add to the dismay of the international community if the invasion occurs and the invaders are successful in achieving their unification of the Korean Peninsula. The

amount of effort required to kick the enemy back beyond the 38th Parallel, in terms of military, political, economic, and human resources, may be prohibitively high.

Of the vulnerabilities, the most difficult node on which to gauge the measure of effectiveness of attack is the product tanker section of the transportation system. The outright sinking of these ships will have immediate consequences for the Allies in terms of economic losses and ominous warnings of impending military problems. However, the enemy would be hard pressed to target enough of them for destruction to bleed the Allies dry. The more subtle approach of contracting these ships off the market will fulfill the crisis requirement for the enemy as well as preserve the investment in cargo for the enemy. The removal of these ships from market denies the Allies quick solutions of placing ships at appropriate refinery or terminal nodes for loading, and also adds to the overall transportation time to get product fuel into theater. This creeping crisis in transportation will act as a multiplier for the enemy once the attack is launched as a synchronized event to coincide with the fuel crisis. The product tanker predicament will affect the world transportation market, the world economy, and fuel prices as these ships are removed from meaningful trade and are absorbed into an enemy scheme to assault military targets. It is strictly the loss of these product tankers from the world charter market that is the critical vulnerability, not the fuel that is trapped onboard. These types of tankers are few in number and always in high demand on any calendar day. Yet, these hard to replace tankers will be spared from destruction, thus only causing a relative short period of pain for the actors in the world market. The enemy will return the tankers to market once the *fait accompli* on the ground in Korea has been carried through. The operational commander will have fought his Korean defensive action in a "come as you are" footing without the assurances of a robust logistics system to bolster his diminishing stocks of fuel, ammunition, and food. There are only two possible outcomes for the operational commander in his fuel-less plight.

THE PRESTIGE OF AMERICA

"If you want to overcome your enemy you must match your effort against his power of resistance, which can be expressed as the product of two inseparable factors, viz., the total means at his disposal and the strength of his will."
Carl von Clausewitz: On War[22]

The operational commander will be faced with the choices of fighting a defensive war in the attempt to borrow time for his resupply assets to arrive in theater from global sources, or employing weapons of mass destruction (WMD) in order to stem the enemy advance and regain the initiative. Each of these choices carries with it great risks for the probability of successfully achieving the objective sought, as well as evolving the conflict into an international disaster that will not be easy to conclude.

The operational commander will naturally choose defensive war as his first response to an invasion. If fuel shortages limit his options for maneuver and thus response, then steady withdrawal toward the southern extremes of the Korean Peninsula will be implemented to shorten land lines of communication and to stall for time awaiting resupply cargoes. These cargoes of fuel, ammunition, equipment, and food will be sourced from around the world in an attempt to balloon the Allied forces capabilities in Korea as quickly as possible. The only transport method with adequate lift capability to meet the requirements of an army in extremis will be sealift. These sealift assets will be awaiting the Allied forces countermeasures efforts in clearing harbors of sea mines and in combating insurgencies within the Allied defensive positions. If the enemy invasion is successful in creating a robust momentum, the operational commander may find himself in a tactical and strategic position where time is a critical factor that he will be unable to manage. With attacks on his fuel resupply sources having been carried out, he will run out of fuel well before emergency measures can be brought to bear on the problem. In his inability to move forward in attack and rollup the invaders, the combined pressures of retreat, enormous civilian casualty and refugee problems, lack of massive and sustained air power projection, and lack of sea ports of entry and exit will drain him of options for avoiding total defeat.

How difficult would the Korean situation have to become in order for the operational commander to request the use of weapons of mass destruction? Could the criteria of vital national interests be irrevocably applied to a country approximately the size of the State of Indiana that would provide the United States with the impetus for utilizing tactical or theater weapons of mass destruction or losing the war? If these weapons were utilized, what of the fleeing civilian population caught in the impact area and the progressive physical spoilage of the environment? There will invariably be the political penalties for employing such weapons upon Asians as well as the argument about killing the patient in order to eradicate the disease. Surely, the United States will be called accountable for the aftermath by the bitter survivors and the nervous world community. A defensive strategy of "response in kind" rings hollow when applied to a small strip of land like the Korean Peninsula, particularly if the hazards introduced by weapons of mass destruction are such that they exponentially increased in the course of a four week war, and these hazards roost amidst more than 14 million people. The disaster of an enemy invasion will have to be stopped by conventional means or not at all.

CONCLUSION

Allied victory in another Korean War may well be jeopardized by lack of fuel availability to the operational commander in the battlefield. Historically, fuel has proven to be the Achilles Heel of fossil-fueled mobile forces, and there has been no substitute for its availability in large quantities in the field or its uninterrupted flow. A clever enemy can destroy the Allied ready fuel supply, theater reserves, and resupply stocks in such quantities that it will have a severe effect on the operational commander and his capabilities to successfully carry out his mission. The enemy is capable of offering the world community *un fait accompli* in Korea by forcing the Allied forces to fight an assymetrical conflict on the ground that places severe time constraints on the operational commander's ability to to garner fuel, forces, and supplies to rollup the invasion. This quandary is a topic that requires further research by the joint force commanders involved in the defense of the Korean Peninsula.

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